NOTES.

WE are informed that the Government is prepared to make the financial arrangements necessary to enable the Imperial Institute to become the headquarters of the Organisation of the New University of London. This decision of the Government was brought before the Senate at its meeting yesterday by the Vice-Chancellor, and it is hoped that no unnecessary delay will occur in receiving the agreement of all parties concerned; while it is doubtful whether a Faculty of Commerce commensurate with the other Faculties can be at once established; it is most important that the various subjects which would naturally be included in it should be taught. This teaching might fairly find a place in the Imperial Institute under the authority and control of the New University. Some of the instruction would be germane to the valuable collection of raw materials, &c., in the Institute.

A VERY considerable discussion of an informal character is now going on among many interested in the various institutions which may form part of the new University. It is to be deplored that there is a great probability of the work of the Commission being hampered by the fact that many of the suggestions now being made are more inspired by the local interests concerned than by the desire to help on the educational question in the abstract. We use the word abstract in no pedantic sense, and with a full appreciation of the concrete questions involved. The Commission has to deal with an area defined by a radius of thirty miles, a population which we may roughly estimate at seven millions, and a large number of existing institutions. The amount of good the Commission will ultimately produce along new lines will, we take it, be capable of measurement by the success it will achieve in coordinating the old forces which are already at work, by working on the principle of organic growth and regarding what exists from the most general standpoint. It is from this point of view that we deprecate some of the suggestions now being made, because, if accepted, they will harm existing institutions, because the new University must not commence by localising itself, however high any local bid may be, and because again no good work will be achieved if any new suggestions be accepted before the actual condition is fairly grappled with, mastered and legislated for.

THE President and Council of the Geological Society will be "at home" to the Fellows on Friday, December 16.

THE *Pioneer Mail* states that the Nizam's Government has sanctioned the immediate construction of a complete and thoroughly equipped Pasteur Institute for Hyderabad. It will adjoin the hospital and medical school, and will be available in about six months for patients.

IN the forthcoming session of Congress, the Hurley Bill, providing for the adoption of the metric system of weights and measures in the United States and its compulsory use in all Government transactions except the completion of surveys of the public lands, will be again brought up. The Bill was defeated by only three votes in the fifty-fourth Congress, and the increased interest since given to the subject will, it is hoped, lead to the adoption of the measure.

A FEW particulars with reference to the discovery of a new system of incandescent electric light, by Prof. Nernst, of Göttingen, are given in *Science*. The light requires neither vacuum nor tender filaments. The essential point of the invention is that when magnesia is heated above 3000° C. (a temperature far above the melting point of platinum), it becomes a good conductor, and a very weak current is sufficient to keep it in an intensely luminous condition. Either direct or alternating currents may be employed, and the magnesia is little injured by use. The preliminary heating Prof. Nernst accomplishes by placing the magnesia in the focus of a reflector. On the inner side of the reflector is a spiral wire of platinum, which when brought to incandescence by a current, produces heat sufficient to render the magnesia a conductor; a current is then passed directly through the oxide by the wire, and that in the spiral is shut off. As advantages over the ordinary incandescent lamps Prof. Nernst claims that the same amount of light can be furnished at one-third the cost, and as the magnesia allows of being heated to a much higher degree than a carbon filament a purer light is obtained. The successful employment of a cheaper substitute for the platinum is also announced, though the name is not made public.

PROF. GEORGE FORBES, F.R.S., referred to the utilisation of the Nile cataracts, in his recent lecture at the Society of Arts on long distance transmission of electric power. He remarked as follows:—"My report on this subject is in the hands of the Egyptian Government, and is their property; but I am not divulging secrets when I tell you that the electric lighting of Cairo could be done cheaper by power generated at the First Cataract than by steam engines at Cairo. The distance is 400 miles as the crow flies. Do not imagine that I propose lighting Cairo immediately in this way. The Government has far more important uses for the power, not only in the irrigation of the country as it is, but still more for the perennial irrigation which will be so much extended when the great reservoir designed by Mr. Willcocks, Sir William Garstin, and Sir Benjamin Baker shall be completed by Mr. John Aird. You may take it as certain that before long the cataracts will be harnessed and forced to assist in developing not only Egypt proper but the Sudan, and especially the Dongola province up to the Fourth Cataract, which, with efficient irrigation, may become the most fertile country in the world."

AFTER several visits to the Orkneys, Prof. Newton succeeded this summer in landing upon the Holm of Papa Westray, a small island lying to the eastward of the larger one, from which it is separated by a comparatively narrow and shallow sound. A survey of Papa Westray in 1888 led Mr. Buckley to believe that he had found the last breeding place—reputed to be thereon—of the Great Auk or Garefowl (*Alca impennis*). The unsuitableness of any part of the island as a breeding place for such a bird was afterwards pointed out; but an examination of the Holm of Papa Westray led to the discovery of a locality adapted in every way to the habits of the Garefowl, and Prof. Newton considers that there is no room for doubt that the Holm was the true home of the species whose extirpation, so far as Orkney is concerned, was compassed in 1813. In connection with this subject it is interesting to mention that Mr. Symington Grieve contributes to the *Transactions* of the Edinburgh Field Naturalists' and Microscopical Society some additional notes on the Garefowl, with special reference to two newly-recorded skins. He states that the existing remains may now be summarised as follows:—Skins, 80–82; skeletons, more or less complete, 23–24; detached bones, 862–874; physiological preparations, 2–3; eggs, 71–72.

THE weather reports issued by the Meteorological Office show that during the month of November the rainfall in different localities has been considerably influenced by the tracks of the storms, some of which have passed to the north and others to the south. Generally speaking, the rainfall has been excessive in the north-west and south-west of our islands, and deficient in the eastern parts. But not unfrequently stations not very far apart have received very different amounts of rainfall. A

Stornoway (Hebrides) the fall was about double the average, the excess being 5 inches; while at Sumburgh Head (Shetlands) there was a deficiency of 0·27 inch. At North Shields there was an excess of 0·95 inch above the mean for the month, while at Leith there was a small deficiency. The following values above or below the monthly mean are noteworthy:—Valencia, + 1·26 inch; Roches Point, − 0·96 inch; Hurst Castle, + 1·25 inch; Dungeness, − 1·83 inch; Holyhead, + 0·08 inch; and Liverpool, − 1·12 inch. Generally speaking, the rainfall since the beginning of the year is still considerably deficient, except in the north of Scotland, where the excess is above 9 inches.

AT the meeting of the French Meteorological Society on November 3, under the presidency of M. Poincaré, M. Teisserenc de Bort presented the first part of a very important work by Dr. Hildebrandsson and himself, entitled "Les bases de la météorologie dynamique. Historique, état de nos connaissances." This part contains the history of all the ancient researches from the time of Aristotle to the present date. In the second part, now in the press, the history will be continued, and will be followed by theoretical questions, such as the distribution of aqueous vapour in the atmosphere, and that of the meteorological elements over the surface of the globe. A paper by M. Coeur de Vache was read on the atmospheric electricity of the months of March 1886–1895, or during a period of 213 days. This investigation shows that the diurnal oscillation of atmospheric electricity depends especially upon the humidity of the air, both with regard to its amplitude and to the normal hourly values. The other papers read related to the unmanned balloon ascents of October 3 last, by M. Teisserenc de Bort, and to the action of the moon on the movements of the atmosphere, by M. Poincaré.

WE have received a copy of "Observations and Researches" made at the Hong Kong Observatory during the year 1897, under the superintendence of Dr. W. Doberck, the director. In addition to the usual observations and results of the meteorological and magnetic instruments, the report contains detailed information upon the other valuable work carried on at the observatory. For the daily weather forecasts a complete success of 65 per cent., and a partial success of 31 per cent., are claimed. Following the method used in some other meteorological establishments, and adding together the sum of total and partial success, the high figure of 96 per cent. is obtained. During the year 1897, besides the meteorological registers kept at forty stations on shore, the log-books of 283 vessels have been copied, for use in the construction of trustworthy pilot charts of the Eastern seas. The report also contains the third edition of the law of storms in the Far East, to which we briefly alluded in our issue of October 20. Dr. Doberck is very sanguine about the results of this investigation, and states that the typhoons, about which little was known when the observatory was built, in 1883, are now among the best understood atmospheric disturbances. A chart is given showing the average tracks of these storms.

THE question of the porosity of thin steel plates under heavy hydraulic pressure having been raised (says *Engineering*), experiments have been carried out at the Washington Navy Yard with the view of settling the point in a practical way. Pieces of sheet steel of $\frac{1}{4}$ inch, $\frac{1}{8}$ inch, $\frac{1}{16}$ inch, and $\frac{1}{32}$ inch in thickness were subjected to a water pressure of 6000 lb. per square inch, and in no case was any percolation found. A $\frac{3}{8}$-inch rivet joining two $\frac{1}{8}$-inch plates also proved tight under the same pressure. A test was also made to determine the friction of water under high pressure, and, while it was inconclusive, there was no evidence that the friction of water under high pressure was any greater than the friction of water not under pressure.

AMONG the methods of reducing a compressed gas to a lower pressure by irreversible transformations, those of Joule's well-known experiment of expansion into a vacuum, and Lord Kelvin's experiment of expansion through a porous plug are the most important, and the recent applications of the Kelvin effect to the liquefaction of gases has added fresh interest to the latter. An investigation of the thermodynamics of the process in question is given by M. A. Witkowski in the *Bulletin* of the Cracow Academy, pp. 282–295. These observations support the view that beyond certain limits of temperature and pressure, expansion of a gas is accompanied by heating instead of cooling, and the author investigates the temperature of reversal for air and for hydrogen. The conclusions tend to show that in liquefying gases by expansion there is no advantage in making the initial pressure too great; a pressure of 200 atmospheres, as employed in Linde's machine, being amply sufficient. The cooling resulting from expansion into a vacuum is rather greater than would be obtained for the same pressures in the Kelvin-Joule apparatus.

THE study of hydrodynamics has been greatly facilitated by the series of reports which have been from time to time brought out dealing with the progress made in the subject during various periods. These include Sir G. G. Stokes' report to the British Association of 1846, Prof. Hicks' reports of 1881–82, Mr. Love's paper on Vortex Motion in the *Mathematische Annalen* for 1887, Prof. Hicks' account of the same subject in his sectional address to the British Association at Ipswich in 1895, and Prof. Darwin's Encyclopaedia article of 1888, on Tides. In *Science* for November 11, Prof. Ernest W. Brown, F.R.S., gives an interesting account of recent progress towards the solution of problems in hydrodynamics which have not been included in these previous reports. The author deals at considerable length with wave motion, viscosity, and two-dimensional discontinuous motion, pointing out that no case of three-dimensional discontinuous motion has been solved. In connection with viscosity Prof. Brown remarks that "in all problems hitherto solved, only the first powers of the velocities are taken into consideration." But a paper was published by Mr. Whitehead, in the *Quarterly Journal of Mathematics* (vol. xxiii. p. 78), dealing with second approximations to viscous motion, notably for the fluid surrounding a rotating sphere; and the conclusions arrived at seem rather to cast doubts on the validity of the ordinary first approximations. As Mr. Whitehead's paper seems little known, the present reference may save some mathematician the trouble of solving the same problem (as did the writer of the present note), and then finding that he has been anticipated.

A RECENT number of the *Revue Scientifique* contains the continuation of an article by M. P. L. Simond on the transmission of plague-virus. It is now well recognised that rats not only herald the advent of plague, but are themselves largely responsible as direct disseminators of the morbific material; but, as M. Simond points out, they do not account for all the subtle means by which the virus finds its way to the human subject. Further careful researches now show that parasites in the shape of fleas are extremely dangerous disseminators of plague-bacilli. Suspicion fell on these vermin, inasmuch as it is far easier to infect an animal with plague by subcutaneous inoculation than it is through the alimentary canal. A large number of experiments have been carried out by M. Simond to test the validity of his hypothesis, and just as Yersin showed that flies could transmit virulent plague-bacilli, so Simond has found that fleas taken from plague-stricken rats can communicate the disease to healthy animals, vermin from such sources containing in their excreta the virulent plague microbes. We have long known that dirt and plague go hand in hand, and M. Simond's instructive researches furnish yet another proof of the cardinal importance of combating the disease by unremitting attention to sanitary conditions.

MR. C. S. STANFORD WEBSTER calls attention, in the *Chemical News*, to a novel production of vortex motion. He states that when the freshly gathered leaves of the native Eucalyptus tree (*Eucalyptus globulus*) are ignited, they project vortex rings in considerable numbers in succession, accompanied by a spluttering noise. The best results are obtained by holding the scythe-shaped leaf vertically and igniting the apex—this being the part where the greatest number of translations are obtained. Mr. Webster thinks that possibly in the production of these vortex rings, blisters are first formed by the extrusion of the cuticular tissues, and, on the blisters bursting, air or aqueous vapour is spontaneously liberated, the rings being rendered visible on their contact with the smoke from the burning external portion of the leaf. The leaves of the small English variety of Eucalyptus possess similar properties to the native product, but in a lesser degree, the rings projected being insignificant in size, comparatively speaking.

WE have received a letter from Mr. Charles W. Purnell, of Canterbury, New Zealand, criticising two of the statements made by Prof. Lloyd Morgan in his notice of Prof. Thorndike's experimental study of animal intelligence (NATURE, July 14). Prof. Purnell sees no reason for denying to animals either "conscious [*i.e.* volitional or purposive] imitation," or "memory as involving true localisation in time and space." The facts adduced by Mr. Purnell, however, are not likely to be denied by Prof. Lloyd Morgan or by any careful observer of animal behaviour. The questions he raises seem entirely to turn on the definition of terms, for a discussion of which we cannot afford space.

THE anthropological part of the *Journal* of the Asiatic Society of Bengal (vol. lxvii.) contains six papers, all of value. The taboo of names amongst the Santals is examined most carefully by Mr. P. O. Bodding, and his explanation of it seems convincing. Taking it in conjunction with other taboos, it seems to be a series of rules for defining and keeping intact the standard of conduct among the members of the tribal family, and it is well to note the scarcely veiled system of polyandry which obtains with regard to the wife of the family chief and his brothers. If this is the survival of an older social stratum, while the taboo existing between the family chief and the wives of his younger brothers marks the rise of a newer order of things, it seems that we have here a most interesting phase of social evolution. The Santals are divided into twelve totemistic septs, and Mr. Bodding also examines the taboos connected with this cult; and in another paper the same author deals with the salutations used by the Santals in a manner to show their bearing upon tribal society. The rain ceremony from the district of Murshidabad, Bengal, by Mr. C. C. Mitra, is highly instructive, especially as the author shows its close connection with Lithuanian and other European customs of modern times. By the same author is a paper on the lizard in Indian superstitition and folk-lore. Mr. E. A. Gait's paper on human sacrifice in ancient Assam is a useful description of this practice according to the tribes among whom it obtains.

THE *Bulletin* (vol. ii. No. 2) of the Madras Government Museum, by Mr. Edgar Thurston, shows how useful has been the work begun by Mr. Risley. The physical measurement and other particulars of the Eurasians of Madras and Malabar, accompanied by excellent photographs, are taken from a sufficient number of persons to be sure that normal results have been obtained, and there is an additional note on tattooing, with illustrations.

MR. HENRY FROWDE, Oxford University Press, announces the forthcoming publication of a monograph on "The Micro-organism of Faulty Rum," by Prof. V. H. Veley, F.R.S., and Lilian J. Veley (*née* Gould). This micro-organism, which is said to have caused damage to the extent of many thousands of pounds, has only recently been isolated.

PROF. WILHELM WUNDT'S "Grundriss der Psychologie" (Leipzig: Engelmann. London: Williams and Norgate) has reached a third edition. The original work, noticed in NATURE, vol. liii. p. 604, 1896, has been revised and slightly enlarged. —Mr. Engelmann has also just published a second enlarged edition of Prof. Karl Eckstein's "Repetitorium der Zoologie." The work has been completely revised, and many additions have been made in the various sections.

A SECOND edition of the late Carl Reutti's "Übersicht der Lepidopteren-Fauna des Grossherzogtums Baden" has been published by the Gebrüder Borntraeger, Berlin. The new edition has been prepared by Dr. A. Spuler, who was commissioned by the Karlsruhe Naturwissenschaftlich Verein and Herr Adolf Meess to undertake the work.—MM. Gauthier-Villars, Paris, have published a second edition of M. de Fonvielle's "Ballons-Sondes," a little volume containing an account of the methods and results of experiments with free balloons sent up with recording meteorological instruments.

THE different methods of recording the movements of seismographs form the subject of a brief, but useful, paper by Dr. Cancani in the last number of the *Bollettino* of the Italian Seismological Society (vol. iv. p. 73). Omitting the photographic method on account of its expense and neglect of details, there remain two others, in one of which the record is traced in ink flowing from counterpoised pens, and in the second on smoked paper by means of very fine threads of glass. Dr. Cancani has recently employed both methods at the Rocca di Papa Observatory, and decides without hesitation in favour of the latter, the diagrams being clearer and the friction of the pointers very much less.

TWO remarkably cheap and good globes—one celestial and one terrestrial—published by Messrs. George Philip and Son, have been sent to us for notice. Each globe is 6 inches in diameter, and is mounted in a solid brass semi-meridian on a polished stand. The celestial globe has upon it all stars down to the fifth magnitude, printed in white upon a dark blue ground; and also some nebulae and star-clusters. The stars are considered to be viewed from a point outside the globe, and not, as is the case with celestial globes usually, from the inside. The globe may thus be regarded as a collection of star-maps mounted for convenience upon a sphere. The terrestrial globe is very clearly printed; it shows ocean currents, steamer routes, and other matters of geographical importance. Both globes will be of assistance to teachers of geography, but their educational value would have been increased had it been possible to include a horizon with each of them.

MESSRS. GRIFFIN AND SONS, LTD., wish attention drawn to the fact that they have recently removed from their old premises in Garrick Street, Covent Garden, to 20–26, Sardinia Street, Lincoln's Inn Fields, London, W.C., where buildings have been specially constructed for their work. The same firm has just published the eighth edition of their catalogue of electrical apparatus, a copy of which has been sent to us. Among the scientific instruments and appliances included in the list are several noteworthy things. It is pointed out that Wimshurst machines with ebonite plates have many advantages over the glass plate machines, not the least being that they are not so liable to breakages. In the section of the catalogue containing apparatus for experiments in voltaic electricity we notice a useful school galvanometer, having several novel features, and constructed in such a way that it can be entirely dismounted so as to explain the method of construction before the students in a class. Great care appears to be taken in the manufacture of resistance coils, all of them being tested and adjusted to within one-hundredth per cent. or one per cent. (according to price) of their value. In the magnetic section an interesting instrument described is Lenard's bismuth spiral for measurements of magnetic fields. The principle upon which the instrument is based is the change of resistance that occurs in bismuth when in a magnetic field; the alteration of resistance affording a means of determining the number of lines of force in the field tested. Many other instruments mentioned in the list show that Messrs. Griffin keep in touch with recent advances and educational requirements.

THE *Electrical Review* for November 25 contains an interesting account, with illustrations, of the electrolytic chlorate works at St. Michel in Savoy. Power is supplied by the river Arc, sixteen turbines, each keyed to a dynamo, being employed. The solution of potassium chloride is placed in insulated vats lined with lead, and having a capacity of 11,000 gallons. The anodes are of platinum-iridium, and the kathodes of iron-nickel alloy. The primary electrolytic action is, of course, the resolution of the potassium chloride into potassium and chlorine; the potassium, however, forms potassium hydrate, and liberates hydrogen at the kathode. The potassium hydrate so formed is now brought under the influence of the chlorine liberated at the anode; and as a sufficient current density is employed to keep the temperature above 45°, the action proceeds according to the equation $6KOH + 3Cl_2 = KClO_3 + 5KCl + 3H_2O$. The chlorate is easily separated from the more soluble chloride by crystallisation. The works at St. Michel, and another at Vallorbes, are said to produce together 1800 tons of chlorate per annum. The introduction of the electrolytic process has resulted in a considerable fall in the price of chlorates.

THE additions to the Zoological Society's Gardens during the past week include a Mozambique Monkey (*Cercopithecus pygerythrus*) from East Africa, presented by Mr. A. D. Michael; a Mantell's Apteryx (*Apteryx mantelli*) from New Zealand, presented by Sir Walter Buller, K.C.M.G., F.R.S.; two Dwarf Chameleons (*Chamaeleon pumilus*) from South Africa, presented respectively by Mrs. Todd and Mrs. C. Faraday Maypee; a Black Ape (*Cynopithecus niger*) from the Celebes, an Osprey *Pandion haliaetus*) captured at sea, a Praslin Parrot (*Coracopsis barklyi*) from Praslin Island, a Bell's Cinixys (*Cinixys belliana*) from Tropical Africa; a Home's Cinixys (*Cinixys homeana*) from West Africa, three Painted Terrapins (*Chrysemys picta*), a Salt-water Terrapin (*Malacoclemmys terrapin*) from North America, three Reeve's Terrapins (*Damonia reevesi*), a Black-headed Terrapin (*Damonia reevesi unicolor*) from China, four Caspian Terrapins (*Clemmys caspica*) from Western Asia, a Japanese Terrapin (*Clemmys japonica*) from Japan, four European Pond-Tortoises (*Emys orbicularis*), European, a Ceylonese Terrapin (*Nicoria trijuga*) from India, two Blackish Sternotheres (*Sternothaerus derbianus*) from Madagascar, a Spix's Platemys (*Platemys spixi*) from Brazil, a Common Chameleon (*Chamaeleon vulgaris*) from North Africa, two Rufescent Snakes (*Leptodira hotamboeia*) from South Africa, deposited.

OUR ASTRONOMICAL COLUMN.

THE NEW COMET CHASE.—This comet seems to be brightening, and is now in a good position for observation. It is moving slowly towards the north-west, being situated now in the southern part of the constellation of Leo Minor, roughly in a prolongation of the line joining η and γ Leonis. The Centralstelle sends us a circular (No. 15), which informs us of the elements and a brief ephemeris computed by Coddington from observations made on November 23, 24 and 25. Another circular (No. 16), which has just come to hand, informs us of more accurate elements and ephemeris which have been computed by Herr. J. Müller from two Harvard photographs taken on November 14, and two Lick observations made on November 23 and 25. These are as follows:—

T = 1898 September 8·192 Berlin M.T

$$\left.\begin{array}{rl}\omega = & 358^\circ\ 43'{\cdot}83 \\ ☊ = & 93\ \ 49{\cdot}05 \\ i = & 21\ \ 35{\cdot}35\end{array}\right\}1898{\cdot}0$$

log q = 0·33144

Ephemeris, Berlin Midnight.

1898.		R.A.		Decl.		Br.
		h. m. s.		° ′		
Dec. 8	...	10 41 13	...	+25 3·2	...	1·4
,, 10	...	10 43 32	...	25 17·9	...	1·4
,, 12	...	10 45 45	...	25 33·3	...	1·4
,, 14	...	10 47 51	...	+25 49·3	...	1·4

THE NEBULA OF ANDROMEDA.—The variation in brightness of a portion of the nebula of Andromeda, as announced by Seraphimoff some weeks ago, does not seem to have been generally corroborated, and the observations of Prof. Barnard (*Astrophysical Journal* for November) do not suggest any variation. In June and July of the present year this observer made a series of measures of the nucleus with reference to two eleventh magnitude stars, one preceding and the other south, and during this time the nucleus was well seen, though not stellar. No trace of the Nova of 1885, although carefully looked for, could be observed. After Seraphimoff's announcement both the 40-inch and the 12-inch telescopes were turned on to the nebula, but "it was evident that no perceptible change had occurred in the nucleus or the nebula itself . . . and the impression has always been that the nebula is unchanged."

Not only this observer, but both Hartwig at Bamberg and Comas Sola at Catala (*Astr. Nach.* No. 3529), record no variation; the former from eye observations and the lattet from photographs taken before and after the announcement mentioned above.

THE PLANET WITT DQ.—In a previous number of NATURE (November 3) we brought together much of the information that had been published concerning the interesting new planet discovered by Witt. The importance of this small planet, which at times approaches the sun nearer than Mars, necessitates that it should be closely watched, and its motion accurately determined. Needless to say, such observations are being carried out in many observatories, so that when a sufficiently large part of the orbit has been described we shall be presented with more accurate elements. The elements previously published by Berberich show now deviations from the true ones as gathered from the observed and calculated positions of the planet. Mr. H. N. Russell, of Princeton (the *Astronomical Journal*, Nos. 448–450), has formed some new normal places from a comparison of several observations, and the elements he has deduced differ somewhat from those previously published. Millosevich, in an interesting contribution to the *Rendiconti della R. Accademia dei Lincei* (vol. vii., series 5A), has also computed some new elements, so we give the following comparison:

	Berberich.		Russell.		Millosevich.	
Epoch.	1898 Aug. 31·5. M.T. Berlin.		id.		id.	
	° ′ ″		° ′ ″		° ′ ″	
M	220 14 3·7		224 33 12·3		222 23 28·7	
ω	178 28 26·2	1898·0	175 47 50·1	1898·0	170 1 20·8	1898·0
☊	0 3 48 53·0		303 20 20·3		303 24 53·1	
i	311 6 57·1		10 45 1·8		10 45 18·1	
φ	13 13 3·8		12 55 13·6		12 49 5·4	
μ	2010″·131		2003″·86		2015″·119	
log a	0·164521		0·1654245		0·163804	
Period	645 days.		646·75 days.		644·06 days.	

Prof. Simon Newcomb, in the same number of the *Astronomical Journal*, refers to the future oppositions of this planet